

# PROGRAM facts

U.S. DEPARTMENT OF ENERGY  
OFFICE OF FOSSIL ENERGY  
NATIONAL ENERGY TECHNOLOGY LABORATORY

Strategic Center  
for Natural Gas

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## FUEL CELLS

### Description

In partnership with the private sector, the National Energy Technology Laboratory (NETL) is developing fuel cells for stationary applications in the utility, industrial, and commercial markets. The program's current focus is on developing molten carbonate and solid oxide fuel cells, and fuel cell/turbine hybrids. An important effort underway is the Solid State Energy Conversion Alliance, an alliance of government agencies, commercial developers, universities, and others that was formed to accelerate development of the industrial base needed to commercially produce low-cost, solid-state fuel cells. The U.S. Department of Energy (DOE) is the largest single funder of fuel cell research and development in the United States.

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### Background

Fuel cells are a revolutionary technology with the potential to fundamentally change the nature of electric power generation. What makes fuel cells unique is that they use electrochemistry rather than combustion to produce high-quality power. Direct current is produced by passing individual fuel and oxidant streams over electrodes separated by an electrolyte. When the fuel is pure hydrogen and the oxidant is pure oxygen, the sole outputs are water, electricity, and heat.

### CUSTOMER SERVICE

800-553-7681

### STRATEGIC CENTER FOR NATURAL GAS WEBSITE

[www.netl.doe.gov/scng](http://www.netl.doe.gov/scng)



*Enabling the emerging trend toward "distributed generation," fuel cells can be sited close to the end-user.*

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## FUEL CELLS

### Program

Since 1995, NETL has managed the Department of Defense (DoD) Climate Change Program to accelerate deployment of fuel cells. We provide grants to prospective fuel cell buyers covering up to one-third of the project cost, with priority being given to DoD installations. This program has cost-shared the installation of more than 200 of ONSI's 200-kW PAFC units.

In recent years, our primary program focus has been development of advanced, high-temperature fuel cells. These fuel cells have higher efficiencies and lower capital costs, and are suitable for the near-term distributed generation market. Our current research partners are Fuel Cell Energy for molten carbonate fuel cells, and Siemens-Westinghouse for solid oxide fuel cells. These systems are being successfully demonstrated in numerous locations, and should be ready for commercial deployment in about 2004 to 2008.

More recently, the Solid State Energy Conversion Alliance (SECA) was formed to achieve the deep cost reductions needed for wide deployment of fuel cells. The alliance includes government agencies, commercial developers, universities, and others committed to the development of low-cost, high power-density, solid-state fuel cells for a broad range of applications. SECA's approach is mass customization of a common 3 to 10 kilowatt module. Fuel cells built from core modules will meet the needs of diverse markets—from stationary power generation, to the military, to the transportation sector. Two DOE national laboratories, NETL and the Pacific Northwest National Laboratory, are the driving forces behind SECA.

Integration of fuel cells and gas turbines offers many advantages. These larger, very high efficiency hybrids will be used in the ultra-clean Vision 21 power plants of the future. Our goal is to have 1- to 20-MW units commercially ready in the 2004 to 2010 time frame. These units will operate at 70 percent efficiency—an unheard-of efficiency at this small size. We are funding several developers of these hybrid systems.

### Benefits

The benefits of widespread fuel cell use are significant:

- Fuel cells are the cleanest fossil-fueled energy generation technology available. Fuel cells currently in development produce only trace amounts of sulfurous pollutants, and reduced, concentrated, and readily captured volumes of CO<sub>2</sub>.
- Fuel cells are more efficient than combustion in converting the chemical energy of hydrocarbons into electricity, which allows them to produce more power per unit of consumed fuel.
- Fuel cells can use a variety of fuels—natural gas, landfill gas, coal- or biomass-derived gas, or alcohols.
- Since fuel cells have few moving parts, they are safe, quiet, and reliable. They can be sited almost anywhere, and they can operate for thousands of hours between forced outages.
- The electricity produced by fuel cells has no spikes or surges, making it ideal for computer-based businesses or hospitals.

Fuel cells can produce energy when and where it is needed. They are a key technology enabling the emerging trend toward "distributed generation," the trend away from large, centralized power stations and toward small, modular power plants located close to the end-user. Their widespread use will benefit the consumer, energy companies, and the public at large.